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ABSTRACT

This study used a computer-assisted cooperative learning approach to teach mathematics to 20 third-grade students, of whom 4 were classified as learning disabled. The team-assisted individualization (TAI) model was used to heterogeneously group students for instruction into four-student teams. Within teams, students were paired. Each team worked at a computer in pairs but completed the assignment independently. Following independent work, each team met to check the accuracy of each other's work and help anyone having difficulty. A weekly quiz was then taken. Three commercially produced computer software packages covering math computation and application at the third-grade level were used. The program was planned and implemented cooperatively by the general and special education teachers and implemented through a four-step process, which involved introducing cooperative learning, having students work at the computer with a partner, having students work in a team, and having teams compete. Outcome measures indicated an improvement in mathematics achievement of 23 percent for general education students and 38 percent for special education students. Students reported that they enjoyed working with partners and teams and developed more positive attitudes toward math. Sample worksheets and a mathematics attitude survey scale are attached. (DB)

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Computer-assisted Cooperative Learning in an Inclusive Classroom

In recent years, inclusive education has been called upon by many educators and parents as a means of integrating students with disabilities into general education classrooms (Haring, McCormick, & Haring, 1994). As students with disabilities are included in general education classrooms with their age appropriate peers, educators are confronting the challenge of adapting curricula and instructional strategies to meet the unique needs of students with disabilities. In inclusive classroom settings, how can teachers help foster successful exchanges among students with disabilities and general education students? Research has indicated that a key factor to answer this question is to find how teachers structure the integration among all students as they work toward their academic attainment and interpersonal goals in the classroom (Johnson & Johnson, 1989). Inclusion of students with disabilities must be linked with appropriate modifications in teaching techniques and strategies away from traditional whole-class instruction to meet the needs of diversity of students (Putnam, 1993). Cooperative learning is one way to enable students with varying needs to work together to accomplish shared learning goals.

Slavin (1990) indicated that cooperative learning could be an effective strategy to provide learning opportunities for students with and without disabilities in an integrated class and helped all students improve positive social interactions. Light and Blaye (1990) found that when the cooperative leaning combined

with computer-assisted Instruction (CAI) better learning outcomes were shown in learning mathematics. The advantages for students working in cooperative groups are: improving achievement and attitudes towards learning (Johnson & Johnson, 1985), increasing positive peer interaction (Hooper, 1992), and motivating student's learning (Fink, 1990).

In this study, the computer-assisted cooperative learning approach was used with 20 third grade elementary students. Four of these 20 students were classified as learning disabled with Individual Educational Program objectives in mathematics. These students had been receiving math instruction from a special education teacher in a special education classroom before they were included in the third grade general education class. Their average math level for this class was at the second grade.

Selection of Cooperative Learning Method

The Team-assisted Individualization (TAI) approach proposed by Slavin (1990) was selected as the model for grouping students involved in the 16 weeks' instruction. TAI approach has been regarded as an appropriate method for grouping students with different academic levels and abilities, as well as teaching math to elementary school students in third to sixth grade (Slavin, 1990). Following the TAI model students were divided into groups of 4 during the instruction. Each group as a team consisted of students of varying levels of achievement, a mix of genders, as well as students with disabilities. Within each team the students were paired by twos and these pairs were re-formed weekly. The

teams were re-grouped monthly. Within each team one student was selected to be the team leader, and within each pair, one student was selected to become the manager. Team members were seated as a group, so that the team could work at a computer in pairs and complete the assignment independently. After the team members completed their work, each team met to exchange the completed assignments, to check the accuracy of each other's work, and to help the one who had difficulty. At the end of each week students in each team took a quiz.

Instructional Materials

The following instructional materials were used in this study:

Computer software

Three commercially produced computer software packages were used. Those packages cover math computation and application at the third grade level. Mathkeys (MECC products) designed to be integrated with Houghton Mifflin Mathematics textbook (1989) was the major program used during the math learning.

Instructional sheet

An instructional sheet was given to each student during the instruction. The instructional sheet included an explanation of the skills to be mastered, the steps to be followed while working at the computer, and the procedures to be followed during the problem solving (See Figure 1).

Worksheet

Each worksheet included 10 mathematics problems that

resembled the problems included in each computer practice session and in the textbook. The worksheets were used by students during daily practice sessions (See Figure 2).

Teachers' Cooperative Team Work

To implement the cooperative learning approach in the classroom, the general and special education teachers decided to work together to plan and facilitate an inclusionary cooperative learning program involving team teaching. Planning was scheduled twice a week to develop lessons plans and to produce the Instructional Sheets, worksheets, and quizzes. They also discussed management issues and teaching techniques. The special education teacher discussed the individual student's IEP goals and objectives with the general education teacher. The general education teacher designed the schedules, teaching techniques, individual assignments with the input from the special education teacher. Based on the team planning, the teachers developed the instruction sheet and worksheet weekly. As a result of their plan, the general education teacher was responsible for the overall instruction and class management while the special education teacher gave individual support to both special and general education students. They also took an equal responsibility to grade student worksheets, quizzes, and provided one another with feedback on their instructional skills. During the entire semester, the teachers planned and worked together as a team. These teachers feel that the inclusionary classroom is not only for students working together but also for teachers.

Organization of Computer-assisted Cooperative Learning

Computer-assisted cooperative learning was implemented through a four-step process. The steps included:

Step 1: Introducing cooperative learning

Initially, the teacher introduced how to build team cooperation to the whole class. Students were then grouped into teams to play a game, so that students could understand their team's function and be familiar with partners. Teacher introduced the class to the major concepts, math problem solving procedures in the session, and computer program related. Each session consists of an Instruction Sheet and a worksheet for class practice.

Step 2: Working at Computer with a partner

After the teacher's instruction, each pair of students was assigned at one computer. Students were required to read the Instructional Sheet, and discuss instructions with their partners. Then two students worked at one computer to complete the section of the program. Each student was required to solve five problems of the Worksheet in the computer section. The partner checked the answers. If the answer was correct, the student would record it in the worksheet. If the answer was wrong, the student must try to solve the problem again with the partner's help. Subsequently, the previous partner continued to solve the next problem, and the student serving as a partner. Students took turns working at the computer to complete their worksheet. When students within a pair got five of the problems

correct, their partners would sign the sheet to indicate that they were certified by the team to complete that day's work.

Step 3: Working in a Team

When the pairs within a team completed the worksheet, the team leader would get the members together to check the answers. If the members had a different answer to a problem, the team would work together or discuss the procedures to determine the correct answer. If someone was having difficulty, other members would offer help. If questions remained, the team would ask for the teacher's help. Then, the team leader collected all the members' worksheets to keep in the team's folder for the teacher.

Step 4: Competing with other Teams

After completing the session, students took a quiz. Special education students took a quiz at their appropriate level. The team leader scored the quiz using an answer sheet produced by the teacher. The teacher checked the scores and computed a team's scores based on the average score of the quiz gained by each team member. At the end of the week, teams would be selected as "Super Team", "Great Team", or "Good Team" based on their scores, and received a team certificate. These certificates were posted on the class bulletin board to show each team's performance.

In the following week, the teacher would provide 10 minutes instruction daily with small groups of students who were at about the same level of math and check students' understanding of the main concepts and procedures to solve problems in the specific session. Students would continue to work with their pairs, and

teams. During the pair and team working period, both general and special education teachers served as a facilitator to provide assistance with questions about the session when students needed a help. The same cycle of teaching, working in pairs at computer, discussing in teams, taking an individual quiz was conducted during the whole semester.

Evaluation of Computer-assisted Cooperative Learning

Outcome measures employed to evaluate the effectiveness of the computer-assisted cooperative learning approach included: a) scores attained on math achievement test; b) students' ratings on a four-point scale (strongly agree, agree, disagree, & strongly disagree) on their attitudes towards math learning (See Figure 3); c) special education students' satisfaction with cooperative learning and inclusive classroom with their general education peers by an interview of individual student with disabilities. The results indicated that during a 16 weeks' cooperative learning, students gained in their math achievement test. This represents an improvement of 23% for general education students, and 38% for special education students compared with the pretest scores at the beginning of the semester.

In addition, 95% of the students reported that they liked to work with partners at the computer. From the survey questions, (e.g. "It's fun to solve math problems". "I like to do math in groups". "Math is more like a game than hard work". "Math is my favorite class".) students responded over 3.4 out of 4.0. While the negative questions were asked, (e.g."Doing math problems

upsets me". "Math class gives me stress". "I feel nervous when taking a math exam".) student responses decreased from 2.5 to 1.5 compared with the pre-survey completed prior to implementing the cooperative learning approach. During the interview of special education students, when students were asked if they liked to be in this class, they said that they had more friends, and more classmates, more activities with their classmates and they liked to be there. When students were asked if they liked their partners and teams they responded that the work was harder, but that they got help when stuck on a problem, and that they learned more in groups and had fun working together. These findings indicate that the cooperative learning approach is likely to have a positive effect on the achievement of students both with and without disabilities (Stevens & Slavin, 1991).

Conclusion

The computer served as a teacher's aide -- an instructional tool, one that was always met with great excitement by the students. Computer-assisted cooperative learning in mathematics instruction provided students at different levels an opportunity to work together. In an inclusive classroom, how to meet a wide range of student needs is a concern for many teachers. Computer-assisted cooperative learning may create a way to facilitate inclusion and assist teachers to meet diverse needs of students at different levels. From our experience of implementing the process of cooperative learning in the inclusive classroom, we found that when learning situations are structured cooperatively,

general and special education students can work together in pairs or teams. Students support and help each other to encourage themselves to accomplish their learning tasks. They learn to accept different views from their team members, understand and learn from each other. This learning experience may motivate students with and without disabilities in their academic achievement and social skill attainment in schools.

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Figure 1

Example: 25 x 3 =

1. write in notepad of computer 25x3
2.
3. [3] sets of □ (← write 25 here)
4. (watch cards at top)
5. (watch as base ten counters go onto the screen)
6. complete any or all regrouping

(6 tens) (15 ones)

carry ten ones over to the tens

7. Figure out what the answer will be by the number of tens and ones.

Example: 7 tens and 5 ones = 75

*8. Write your answer in the notepad

9. = (look at completed problem to the right and also tap Marloo who should answer you.)

Now - using this same computer, your partner will switch jobs with you and you will complete # _____

Figure 2

Name _____ Teacher _____

Date _____ School _____

DAY 1	8

12	14	30	11	13	223	132	61
x 3	x 2	x 3	x 7	x 3	x 3	x 2	x 0

DAY 2	8

17	25	112	227	15	62	128	38
x 2	x 3	x 6	x 3	x 5	x 5	x 3	x 2

DAY 3	6

23	128	402	18	238	129
x 4	x 3	x 5	x 6	x 2	x 3

Day 4	6

155	235	159	353	167	298
x 2	x 3	x 2	x 4	x 5	x 3

Figure 3

Mathematics Attitude Survey Scale

Directions: Please listen to your teacher. She will read a sentence to state some information.
If you strongly agree with the statement, circle the 4.
If you agree with the statement, circle the 3.
If you disagree with the statement, circle the 2.
If you strongly disagree with the statement, circle the 1.
Let's start.

1. It's fun to solve math problems.

   1 2 3 4

2. I like to do math problems in groups.

   1 2 3 4

3. I sometimes do more math than what is required.

   1 2 3 4

4. I don't like math very much.

   1 2 3 4

5. Working with number is fun.

   1 2 3 4

6. Doing math problems is boring.

   1 2 3 4

7. Math is more like a game than hard work.

   1 2 3 4

8. If I find a math problem hard, I would work harder.

   1 2 3 4

9. I always complete my math assignments.

   1 2 3 4

10. When doing math I skip the hard problems.

    1 2 3 4

11. I like to do extra work in math when I have time.

1 2 3 4

12. Math is my favorite class.

1 2 3 4

13. I always try to get good grades in math.

1 2 3 4

14. Doing math problems upset me.

1 2 3 4

15. I worry a lot about how I am doing in math.

1 2 3 4

16. I feel nervous when taking a math exam.

1 2 3 4

17. Math class gives me stress.

1 2 3 4

18. I am afraid of not doing well in math.

1 2 3 4

19. I feel at ease when doing math problems.

1 2 3 4

20. I feel upset about my math grades.

1 2 3 4